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ABSTRACT

This paper, presented at the 1979 meeting of the American Educational Research Association (AERA), focuses on curricular interventions which have been used by the University of Minnesota to reduce mathematics anxiety among adults. It summarizes four approaches for dealing with the problem and describes the model used by the Math Anxiety Program of the University of Minnesota. An examination for the four components of this program and special considerations in curricular interventions for adults are presented. The four components examined individually are: (1) mathematics anxiety diagnostic clinic; (2) mathematics classes; 3) mathematics anxiety support group; and (4) mathematics tutorial. Applications of the intervention program for people ir business and industry are also included. (HM)

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INTERVENTIONS IN MATH ANXIETY FOR ADULTS

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Research Association National Convention
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Adults affected by math anxiety pose special concerns in diagnosis and treatment. While the causes of math anxiety are similar for adults, adolescents and children, several factors make intervention both easier and more difficult for adults.

Rarely do adults form a distinct or even easily identifiable group. Their needs and goals are as diverse as their ages, level of education, level of math education and occupations. The following reasons have been given for participating in the Math Anxiety Program offered through Continuing Education for Women at the University of Minnesota and reflect the wide range of goals adults have for learning or re-learning math skills:

- as a prerequisite or requirement for a degree program
- for more effective job performance
- to prepare for a promotion
- to be able to use math more competently in everyday math situations
- to help children with math
- to increase performance on such standardized tests as GRE, GMAT
- to gain self confidence in math and improve self image in general

For most adults the problem of math anxiety has become engrained over a long period of time. And for most, a considerable gap in time has occurred since math skills were learned and used and the present. The average age of participants in the University of Minnesota Math Anxiety Program (Hendel, 1977) was 38; the average number of years which had elapsed since formal math education was 18. Since most adults use only basic arithmetic skills in day-to-day life, and since math attitudes often develop as early as elementary school, the attitudes that

adults hold toward mathematics and their own math ability are well solidified.

On the positive side, however, adults have usually experienced the effects of their anxiety and lack of math skills in loss of career options or limited effectiveness in their work or day-to-day operations. In returning to school their motivation seriousness in studying are high. Because they have self-selected themselves into a math program and feel the need for overcoming their anxiety about mathematics and their lack of math skills, their chances for success are great.

Models of Intervention

There are primarily four types of curricular interventions which have been implemented in the treatment of math anxiety:

1) remediation
2) manipulation of course content
3) psychological intervention and
4) integrated approach.

Each of these have varying degrees of effectiveness for different audiences.

Remediation is based on the theory that at the heart of the problem of math anxiety is merely a lack or loss of math skills. Remediation involves simply learning or relearning math skills at a particular level. This method seems most useful where the individual's anxiety is tied to a specific level of mathematics or where the anxiety level is relatively low. For some, learning what was never understood before eases the anxiety and makes it possible for the individual to move onto other levels of mathematics.

Another approach in the treatment of math anxiety is based on the concept that restructuring the material will make it more easily understood and attractive, thereby lessening anxiety. Examples of manipulation of course content include math labs, individualized instruction, math games, and the discussion method of learning. A wide range of views exist on the real impact these have. Manipulation

of course content seems most effective as a means of attracting individuals with low motivation to learn or relearn math. Since adults in general have high motivation when they begin a class, this seems to be the least effective technique for this group and, again, best for those whose anxiety about mathematics is relatively low.

Psychological intervention refers to the use of counseling techniques to reduce math anxiety. Such techniques may include systematic desensitization, assertiveness training and one-to-one and group counseling techniques to examine attitudes and behavior. By itself, it is most effective for people whose math anxiety is so high that it prevents them from enrolling in a math class or taking other steps which would lessen the anxiety they have toward mathematics.

The integrated approach combines math coursework with psychological interventions. Math anxiety is dealt with on both affective and skill levels. This approach is the most useful in dealing with a wide range of anxieties and levels of mathematics. Furthermore, problems can be dealt with through the psychological intervention as they arise in the coursework. Skills can be learned which will ease the transition from the "protected" math classroom to other more threatening math situations (e.g. on the job).

An example of the integrated approach will be examined more fully.

The Math Program at the University of Minnesota

A model for the reduction of math anxiety in adults has been successfully developed at the University of Minnesota in Continuing Education for Women, using the integrated approach. In its three years of existence it has served over 800 men and women between the ages of 16 to 69. The planning stages began in 1975 and involved seven departments within the University.

The Math Anxiety Program has four components, each of which will be explored individually:

1) Math Anxiety Diagnostic Clinic

2) Math Classes

3) Math Anxiety Support Group

4) Math Tutorial

The Math Anxiety Diagnostic Clinic tests the participant's math ability and level of math anxiety. Instruments used included the Mathematics Anxiety Rating Scale (Richardson and Suinn, 1973) to measure math anxiety, a Diagnostic Clinic Questionnaire to obtain background information and goals of participants, and a self-scoring math ability test designed to reduce fear of negative evaluation and provide concrete information on what math skills participants have accessible to them at this time. Information obtained through testing is used in four ways:

1) to advise participants in math course selection

2) to provide a profile of each individual's problem with mathematics

3) to provide a basis for the structured experiences in the Support Group and

4) to provide comparative data for post-testing for feedback to participants on the progress they had made and for program evaluation.

In addition to the goal of assessment, the Diagnostic Clinic also helps participants begin to explore why they have trouble with mathematics, what math anxiety is, what they can realistically expect in studying math again and how to approach problem solving. The Clinic is used both for assessment and motivation.

A wide range of mathematic classes are an integral part of the Math Anxiety Program. Arithmetic and Elementary Algebra is offered as a noncredit course. Credit courses include Intermediate Algebra, Statistics, Financial Mathematics, College Algebra, and Calculus. Approximately 60% of those who participate in the Diagnostic Clinic test back to fractions and are placed in Arithmetic and Elementary Algebra. Because it is noncredit, it is the only course in which it is possible to manipulate content. A combination of group lecture and individualized instruction is used. Upon completion of this course students may receive credit under a special

procedure, a system established to remove pressure for grades while retaining the credit option. All of the credit courses may be audited. Most importantly, all instructors are chosen for their ability to work with people who are anxious about mathematics.

The Math Anxiety Support Group, concurrent with the math classes, is a structured program led by a counseling psychologist. This phase of the program, especially beneficial for those with very high levels of math anxiety, helps participants develop specific tools for dealing with math anxiety that are applicable to all math situations. Activities in the support group include a mathematics autobiography, sentence completion questionnaire, a mathematics diary, weekly goal setting relevant to studying mathematics, discussion of math study skills, assertiveness training to help students raise questions in class, systematic desensitization, and math games.

The Math Tutorial, available to students of all classes once a week, is an additional opportunity for students to receive one-to-one help with math skills.

In June, 1977 post-test data, using the Math Anxiety Rating Scale, was collected from 47 of 70 participants who began the Math Anxiety Program in September, 1976. (See Appendix.) The results of this study showed a slight but insignificant reduction in math anxiety as tested by the Math Anxiety Rating Scale for those who participated in Math Anxiety Diagnostic Clinic only, a substantial reduction for those who participated in Diagnostic Clinic and math class only, and by far the greatest reduction and most significant (at $p \leq .01$) reduction for those who participated in the Math Anxiety Diagnostic Clinic, math class and Math Anxiety Support Group.

Special Considerations in Curricular Intervention for Adults

Two factors are of prime importance in designing curricular interventions for adults.

First of all, it must be remembered that adults who are continuing their education in mathematics have a wide range of motivations for doing so, diverse backgrounds and experiences, and many constraints on their time and energy. Any curricular intervention for adults must be structured to provide participants easy access into and out of specific components, and components with the greatest amount of flexibility to meet a wide range of needs. (For example, at the University of Minnesota, it has been found useful to have the Support Group distinct from the math classes so that only those who feel it would be useful for them (high anxiety group) need enroll and so that participants from six levels of math classes will have access to supportive services.)

Secondly, faculty selection is one of the most critical factors in the success of a program, its ability to retain students and the students' ability to master course content. Aiken (1976) found the instructor significantly more influential in the development of attitudes towards mathematics than the curriculum. Evaluation of the Math Anxiety Program at the University of Minnesota (Hendel, 1977) found almost all positive comments to which students attributed their success focusing on the instructor: his/her approachability, willingness to help students individually and ability to present material clearly.

Applications of Model for Business/Industry

These same considerations apply to interventions/training programs for people in business and industry with the following additional variables:

1) In a given business location, the need for mastery of mathematics at specific levels will be more obvious and focused.
2) The risk of admitting one's weaknesses in mathematics will often be perceived as more threatening as it may be tied in with job performance or perceived job competence.
3) People who use math regularly are often highly anxious about math and this anxiety usually focuses on lack of math ability

outside of a limited area or fear that math skills are not sufficient for job expansion. (Findings from the University of Minnesota Math Anxiety Program offered at three highly technical business locations.)

4) Pressure to learn math will be higher since promotion often depends on use of math skills or their application.

5) Time constraints are even greater when release time for employees is involved. Each component must be structured in light of that group's particular needs. (i.e. In one company the Math Anxiety Support Group was offered as a series of lectures, rather than an on-going group, which participants could attend as needed.)

6) Company support (financial or otherwise) of participation provides strong incentive for employees to do something about their lack of math skills.

The focus for intervention is somewhat different when developed in a business or industrial setting, as opposed to an educational setting, yet it can be extremely effective because of its opportunities for more specific focus on more easily defined needs. Since the majority of adults are seeking development of math skills for job-related reasons, offering a program at business or industrial site can be an extremely effective opportunity for growth and development of math skills and overcoming math anxiety.

University of Minnesota
Math Anxiety Program
Fall, 1976

A Comparison between Pre-Intervention and Post-Intervention MARS Scores, by Group

Group	September 1976 $\bar{x}$	SD	February 1977 $\bar{x}$	SD	t-value
No Intervention (N = 28)	248.71	58.16	234.39	66.88	2.17*
Course Only (N = 8)	207.12	60.27	169.87	46.29	2.60*
Course and Support Group (N = 11)	251.18	65.56	177.54	34.91	3.78**
	F = 1.64		F = 6.11**		

*$p \leq .05$

**$p \leq .01$

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